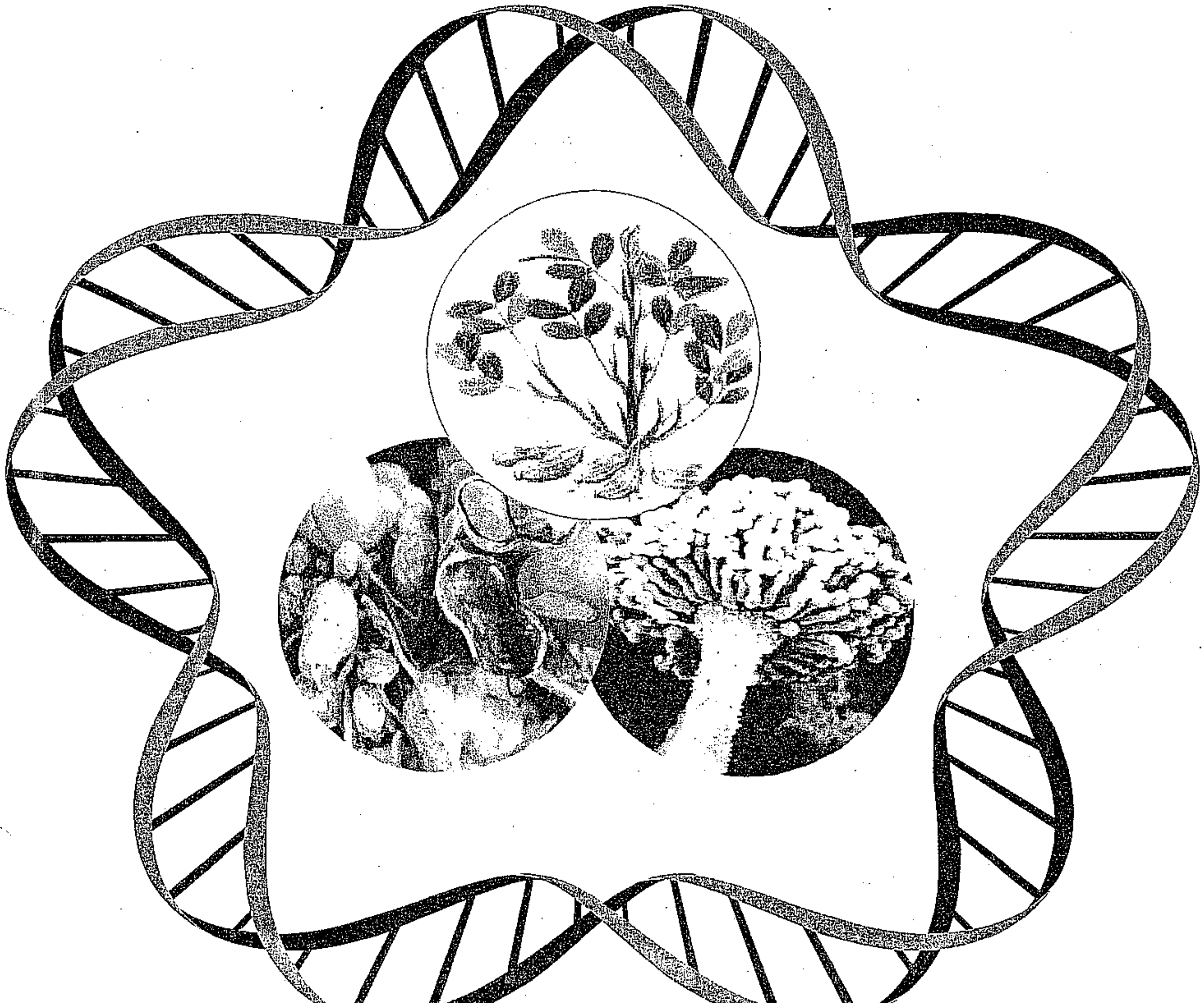
GROUNDNUT AFLATOXIN
Management & Genomics



International Conference

5 – 9 November 2006, Guangdong Hotel

Guangzhou, Guangdong, China

Program and Book of Abstract

ICRISAT

Peanut Collaborative Research Support Program

USDA

Strategies for the Management of Aflatoxin Contamination in Groundnut

F. Waliyar, P. Lava Kumar, S. N. Nigam, K. K. Sharma, R. Aruna, D. Hoisington and C. L. L. Gowda International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India

Since the discovery of aflatoxins (AF) in groundnut meal during the 1958 outbreak of Turkey-X disease, extensive investigations have established that AF are hepatotoxic and highly carcinogenic secondary metabolites produced by *Aspergillus flavus*, *A. parasiticus* and a few related fungal species in several crops and processed foods under certain environmental conditions, and can pose a serious threat to human and animal health, as well as trade. Groundnut is one of the most susceptible crops to the *A. flavus* invasion and AF contamination because of subterranean development of pods and soil-born nature of the fungi. The extent of aflatoxin contamination depends on the geographic location, environment, cultivar, cultural practices, including harvesting and drying and curing, and processing and storage conditions. Preharvest aflatoxin contamination is most frequent in groundnut cultivated under rain fed conditions and drought at maturity stage exacerbates the fugal invasion and aflatoxin production. High temperature and humidity during harvesting and storage also lead to further invasion of the fungi and higher production of the toxin in the seeds. AF contamination in groundnut is responsible for huge revenue loss around the world. In the USA alone crop revenue loss and the cost of research and monitoring activities for groundnut exceed $25 million annually. Groundnut export shares in Asia and Sub-Saharan Africa region have declined by two thirds during the last four decades primarily attributed to high incidence of AF contamination.

Worldwide research efforts are ongoing to prevent AF contamination in groundnut with a main focus on development of germplasm resistant to seed infection, seed colonization and toxin production by *A. flavus*. This has resulted in identification of a few genotypes with low *A. flavus* incidence or AF content, but the resistance was found to be highly variable in the field due to high genotype x environment interaction. Integrated crop management practices that combine genetic as well as cultural practices to suppress *A. flavus* infection are being advocated as an effective strategy. This involves, deep-ploughing; soil inversion; use of biological and chemical pesticides as deterrent for the fungus; soil amendment with lime, farmyard manure and crop residues; protective irrigation; improved postharvest drying methods (row drying, batch drying); timely removal of pods and drying to less than 10% seed moisture; and picking out and separating infected pods prior to storage. Several biocontrol agents (atoxigenic *A. flavus* strains, *Trichoderma*, Pseudomonades, Actinomycetes) that can counteract *A. flavus* by competitive exclusion have been identified and field studies have demonstrated their potential in reducing the AF contamination. Establishment of reliable groundnut regeneration and transformation system allowed introduction of various antifungal genes (encoding for chitinase, lipase, ribosome inactivating proteins, anti-apoptotic protein, chloroperoxidase) into groundnut as a possible approach to prevent *A. flavus* infection and such transgenic events are at various stages of development and evaluation. All these strategies were shown to have the potential for containment and minimization, but not elimination of AF contamination in kernels. Moreover efficacy of several of these technologies depends on environment, and adoption of some of the cultural practices or cost intensive methods such as use of pesticides, biocontrol agents, may not be feasible to the smallholder farmers for various socioeconomic reasons.

Efforts are being continued worldwide for identification of genetic resistance for sustainable protection by evaluating new germplasm and inter-specific derivatives of wild *Arachis* species. Low-cost ELISA test that allows high throughput testing of AF has enabled to overcome a major hurdle in rapid evaluation of germplasm for AF resistance. Recent developments such as availability of whole genome data of *A. flavus*; development of ESTs and microarrays for groundnut; and findings from host-fungus interaction studies may contribute to the comprehensive understanding of the resistance mechanisms in groundnut and may lead to the development of new tools that can aid the precise selection of germplasm for AF resistance. Efforts are also being continued to identify novel anti-fungal and anti-aflatoxin genes, and aflatoxin-detoxifying enzymes for use in genetic engineering approaches. These recent advancements in conventional and advanced molecular biotechnologies are expected to augment resistance to pre-harvest aflatoxin contamination.